Objective, Probabilistic and Verifiable Seasonal Predictions of Meteorological Drought for the US and Mexico

Bradfield Lyon

International Research Institute for Climate and Society
The Earth Institute, Columbia University

with

Arun Kumar (CPC) and Marty Hoerling (ESRL)

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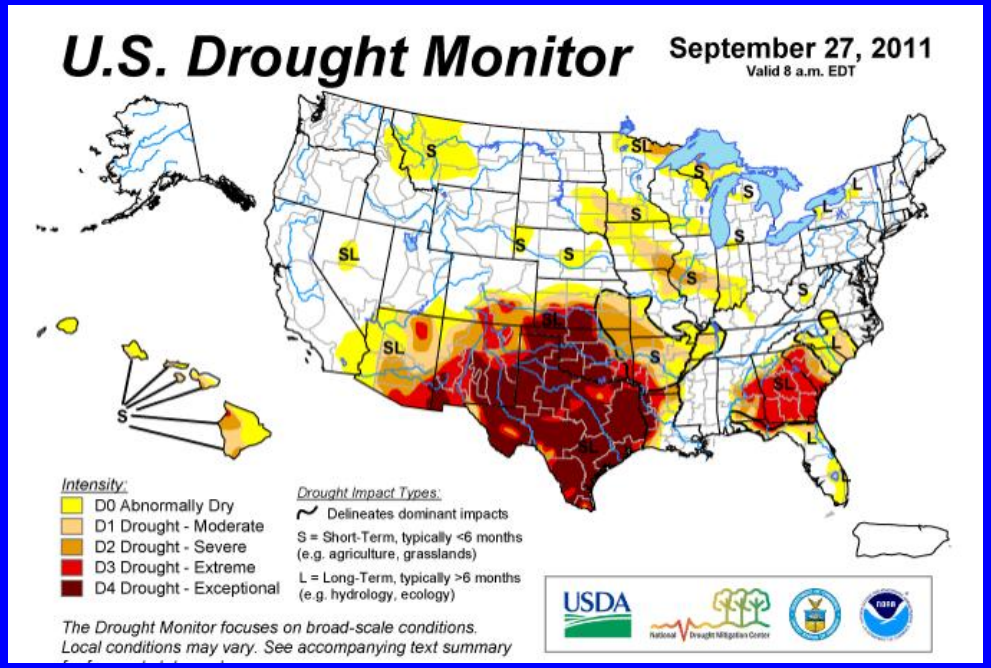
Drought Monitoring

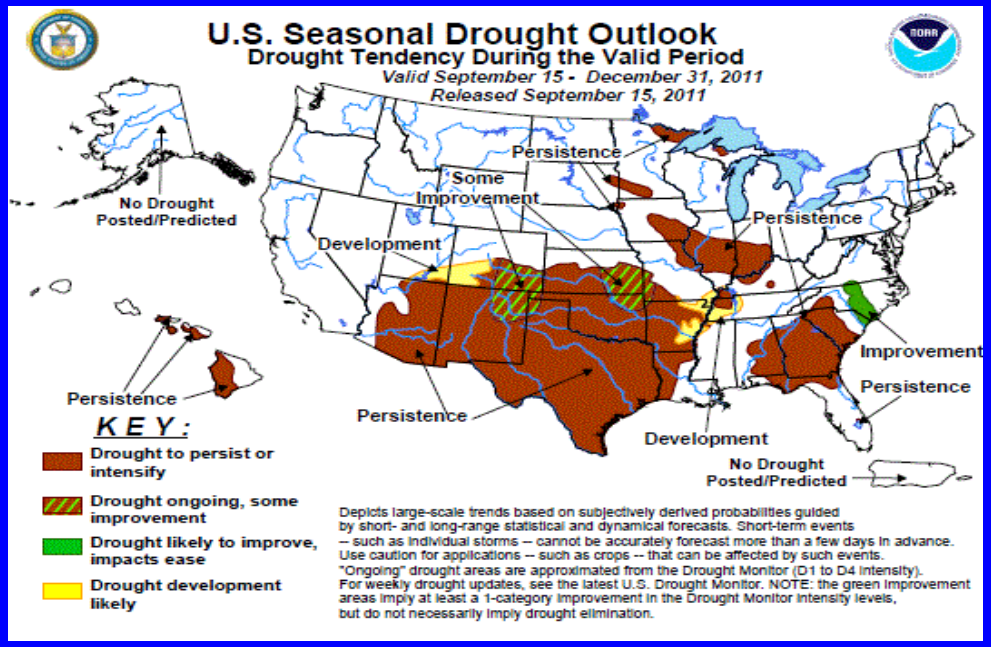
Synthesis of multiple drought indicators...



Drought Prediction

What do we want to predict?

- For decision-makers, the most relevant variable (e.g., reservoir inflow)
- As a general tool, drought indicators on multiple time-scales



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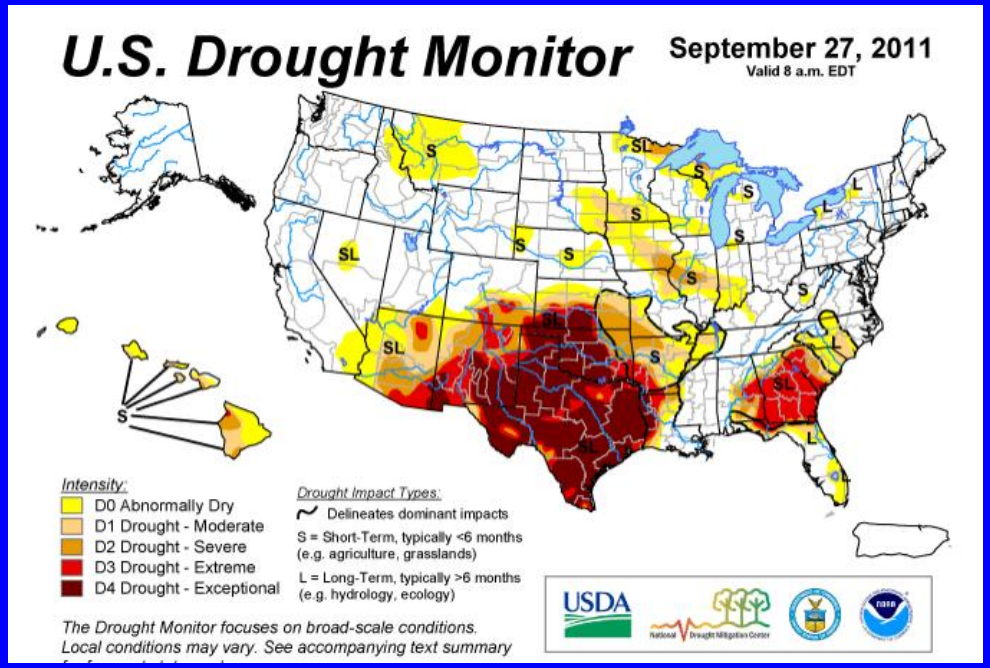

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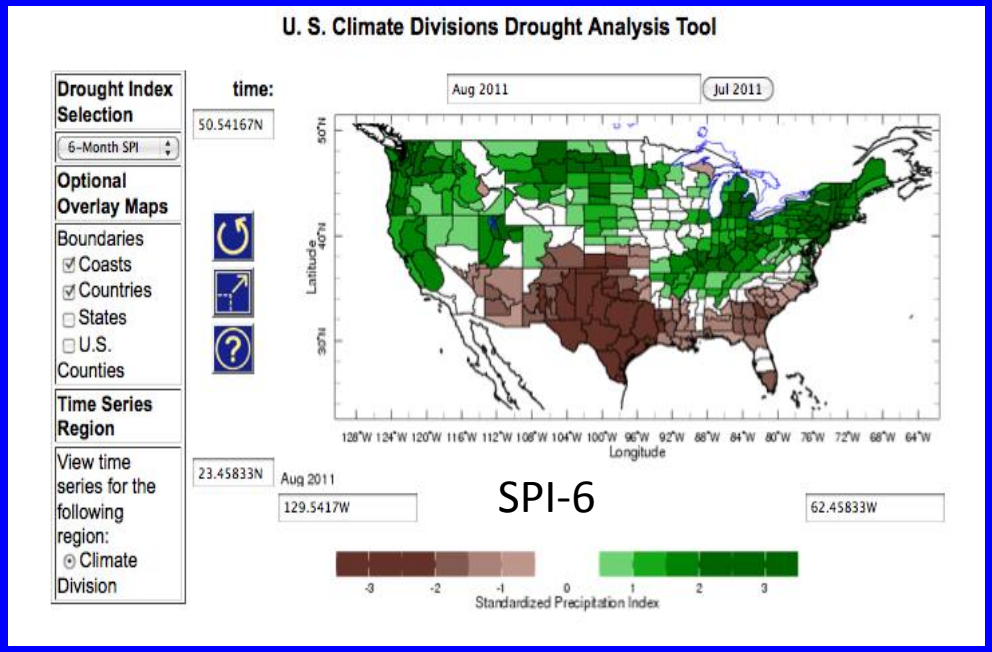
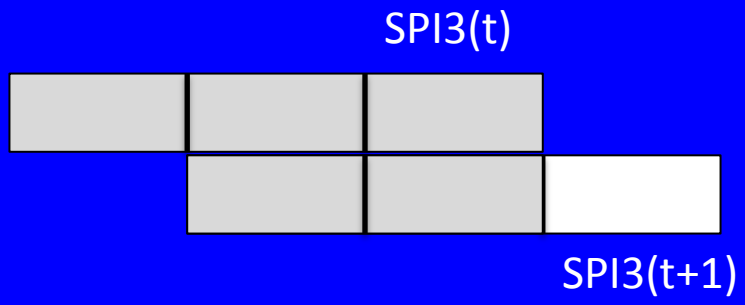


Meteorological Drought Prediction

Based on the standardized precipitation index (SPI) evaluated for 3, 6, 9 and 12 months

- Establish baseline probabilities given the inherent persistence characteristics of the drought indicators
- Examine where AMIP-style and coupled models (CFSv1) exhibit predictive skill which exceeds the baseline
- Incorporate the IRI multi-model ensemble (7 models) PRCP forecasts into web-based drought prediction tool. Additional analysis and prediction tools have been developed.

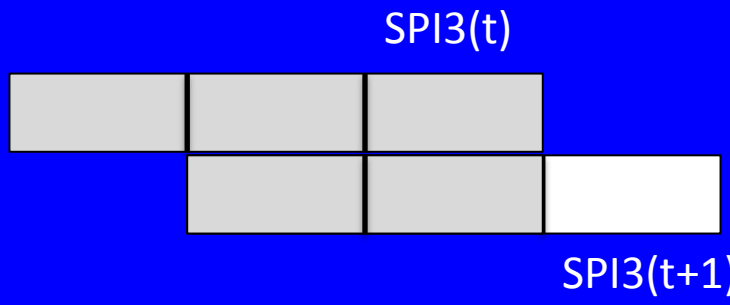
Inherent persistence of drought indicators



To establish baseline persistence, scramble observed data to generate synthetic time series with no serial correlation and compute AC:

- Ignore seasonality of monthly PRCP
- Include seasonality
- Take median value of AC from 100 time series

Inherent persistence of drought indicators



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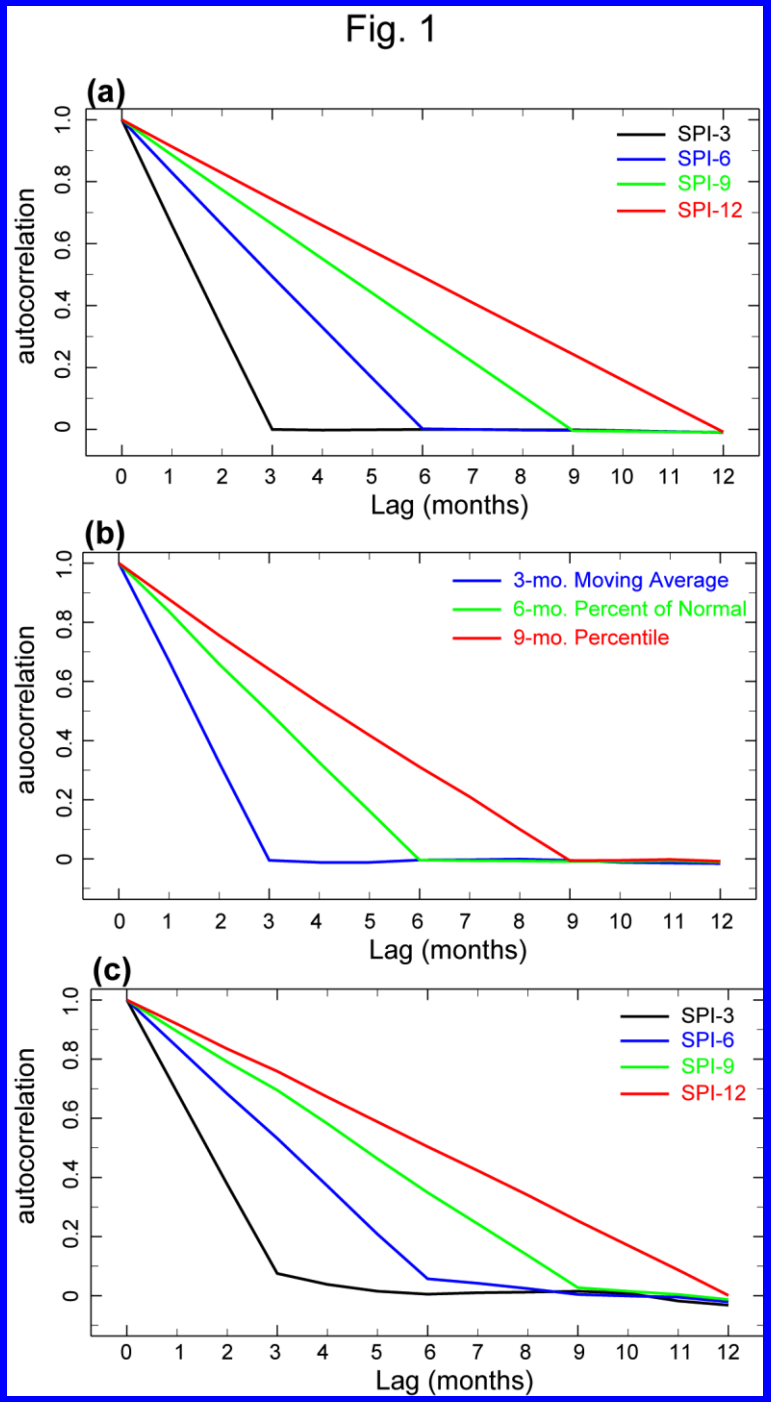
Lyon et al. 2011, JAMC (in revision)



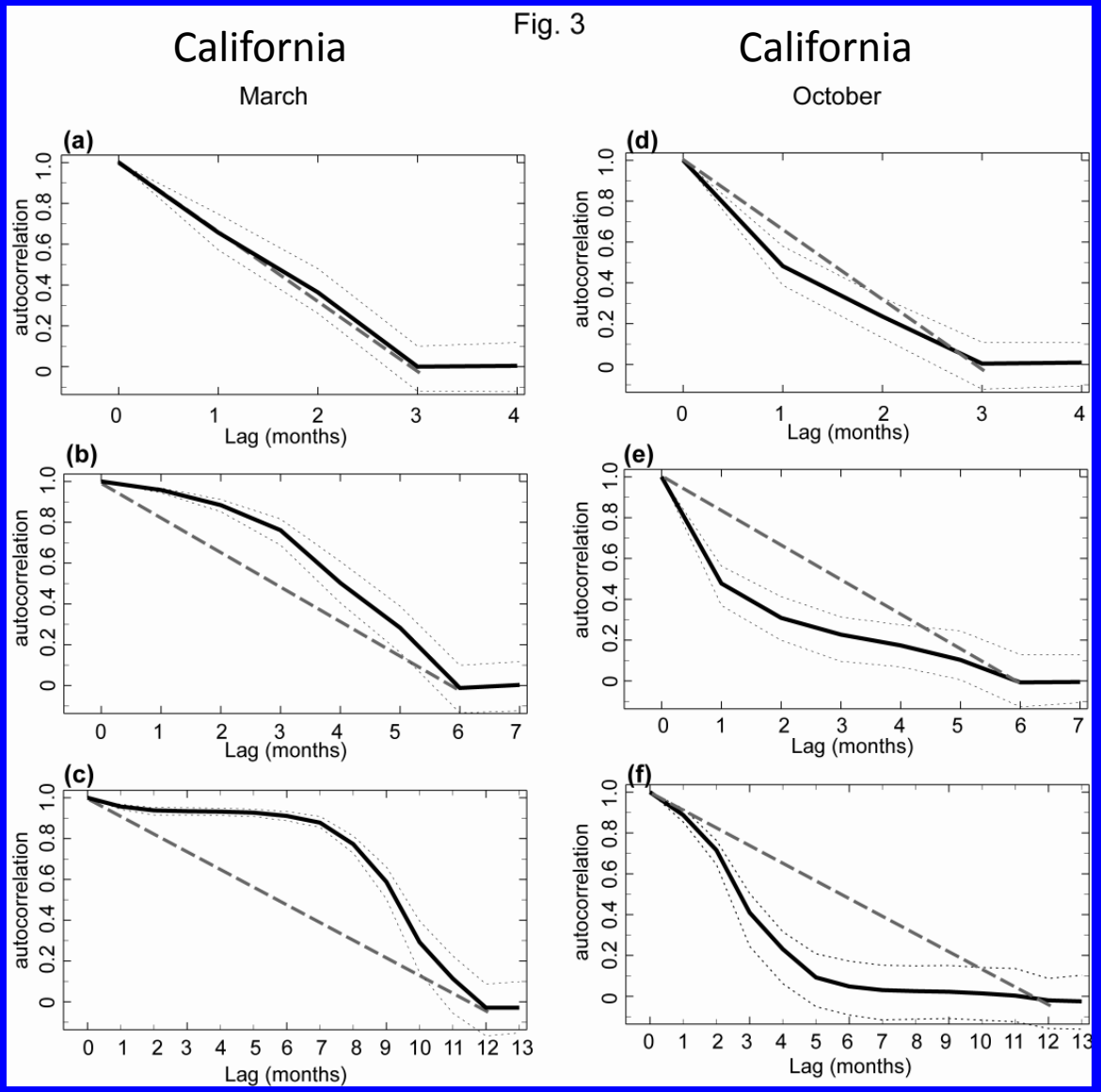
Inherent persistence of drought indicators

Include Seasonality

SPI3

SPI6

SPI12



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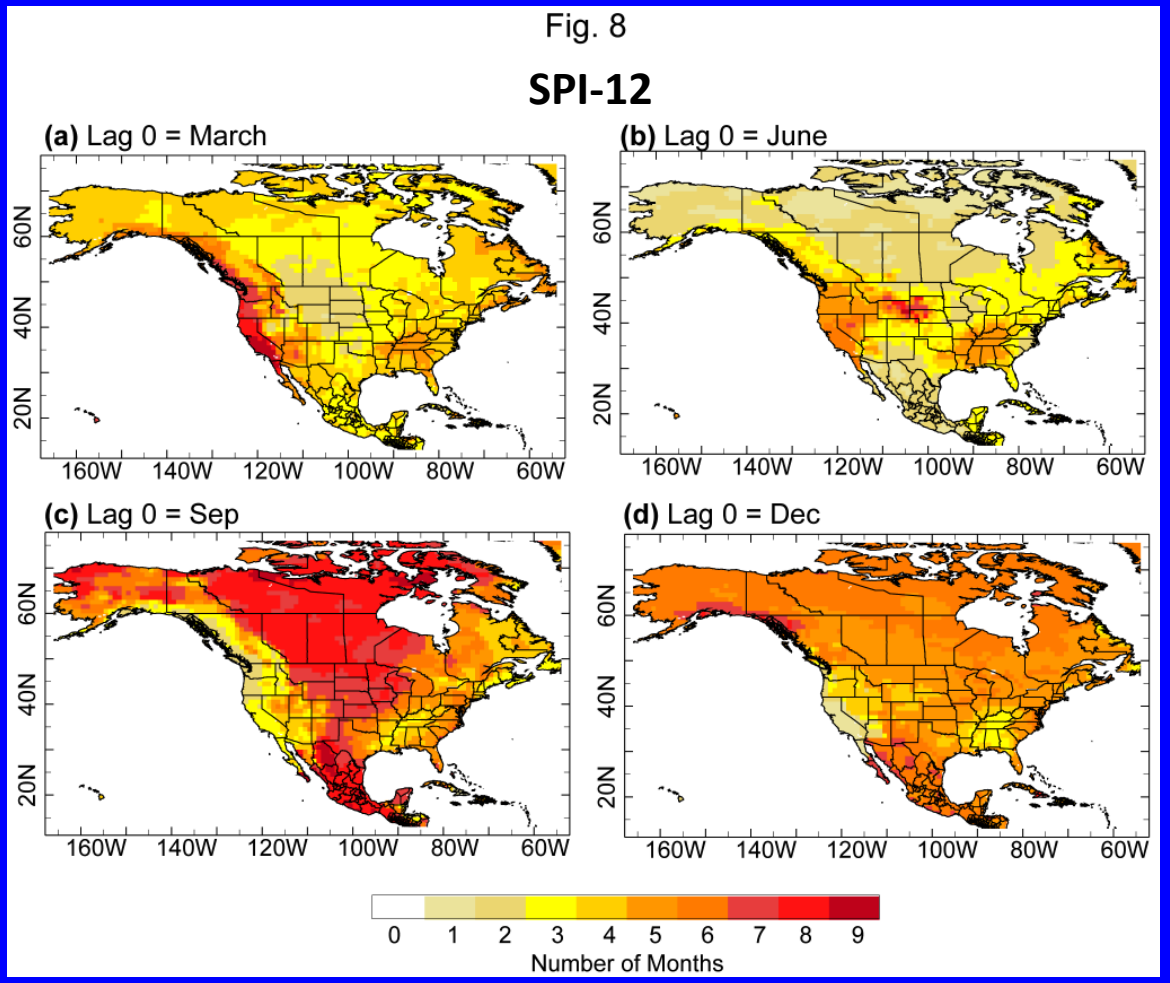
Inherent persistence of drought indicators

Useful Predictive Information:

Number of consecutive Months with AC > 0.6



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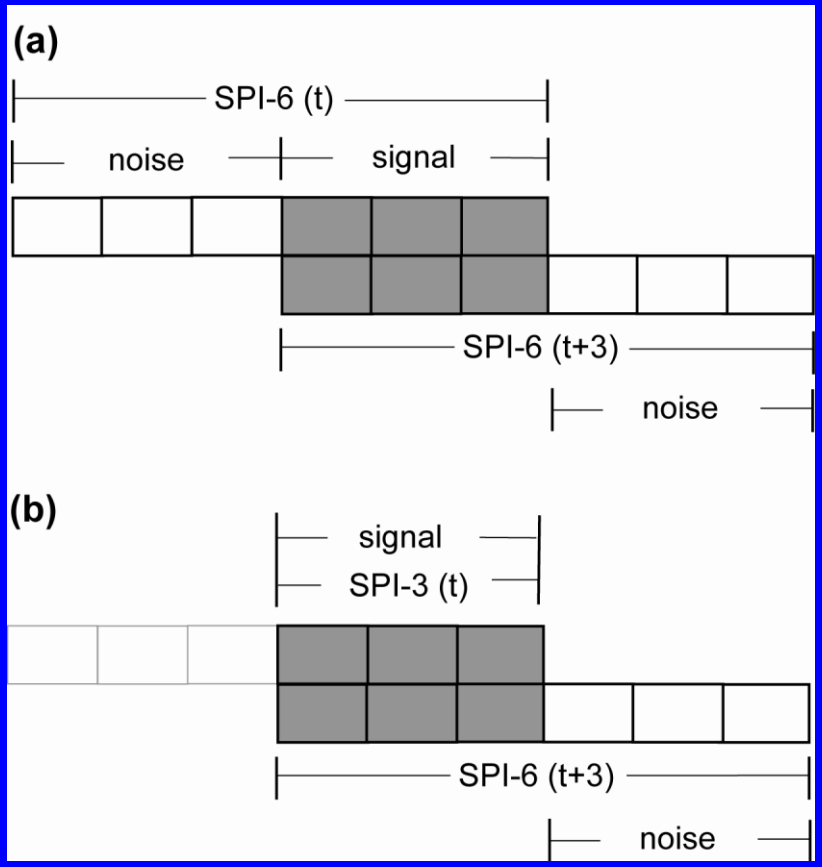
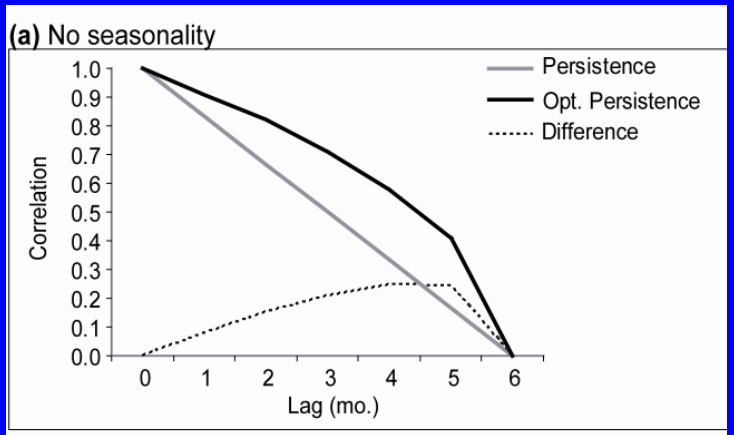
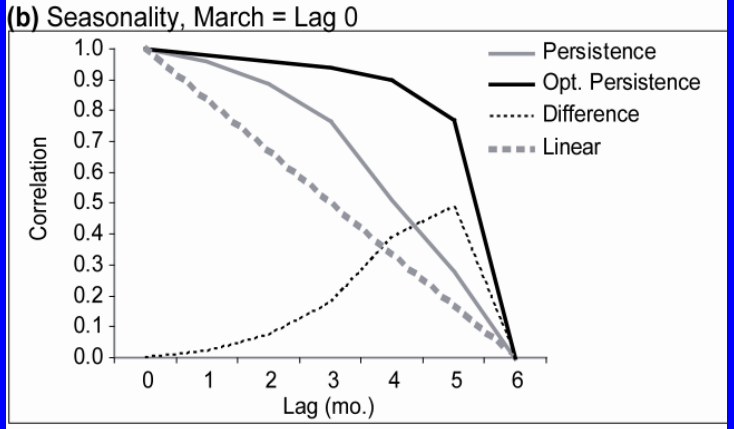
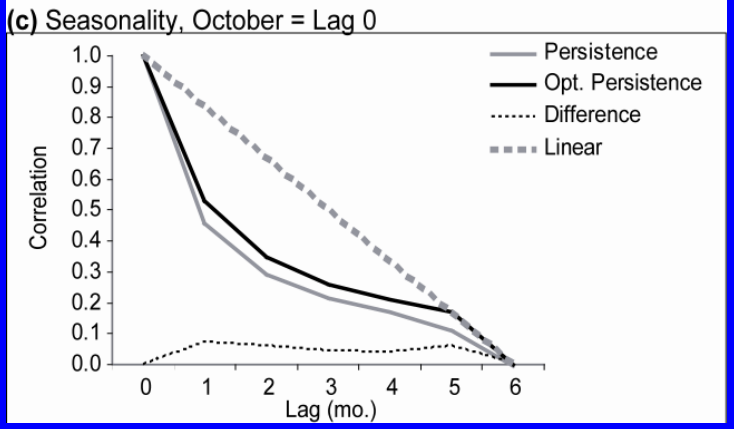
Inherent persistence of drought indicators

"Optimal" Persistence









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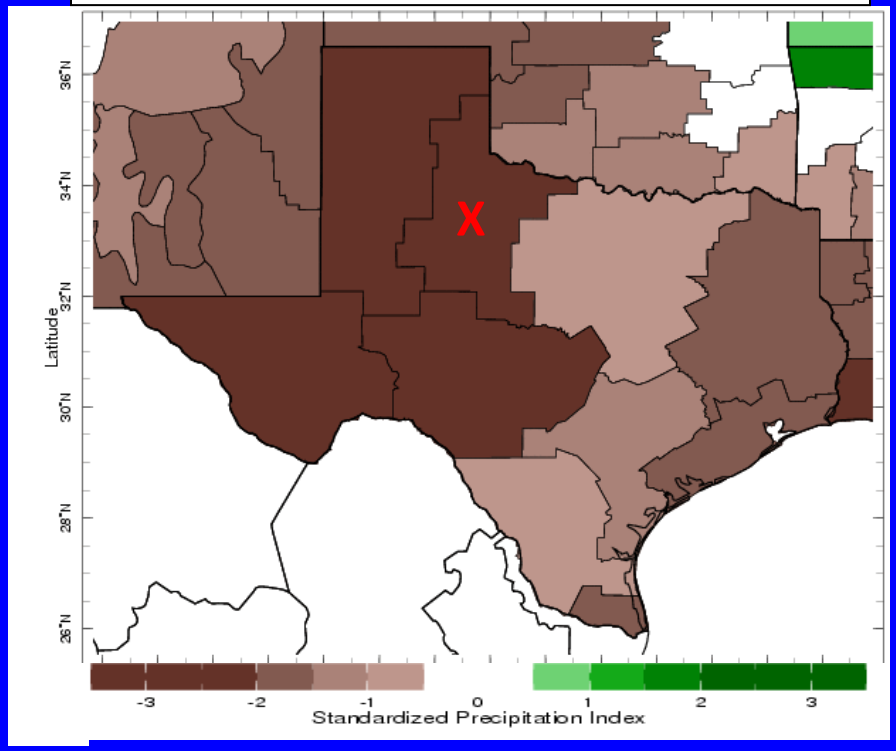
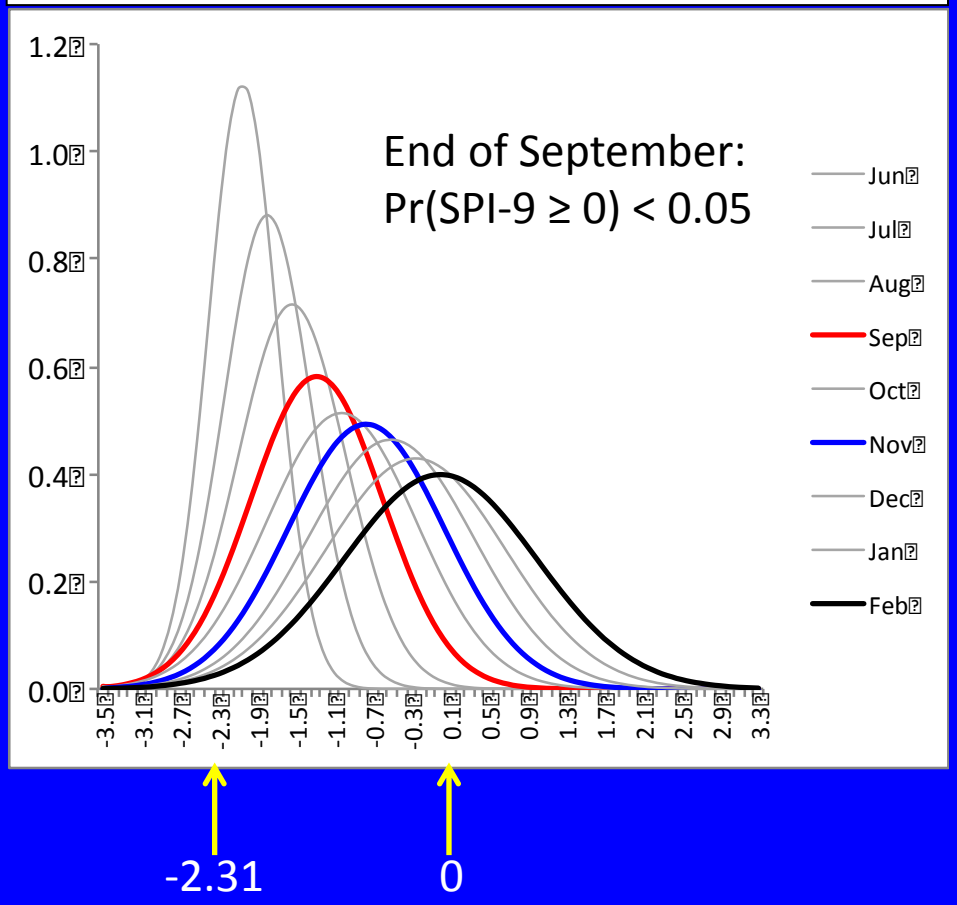
Inherent persistence of drought indicators

DIVISION 2
SPI9 = -2.31
MAY 2011

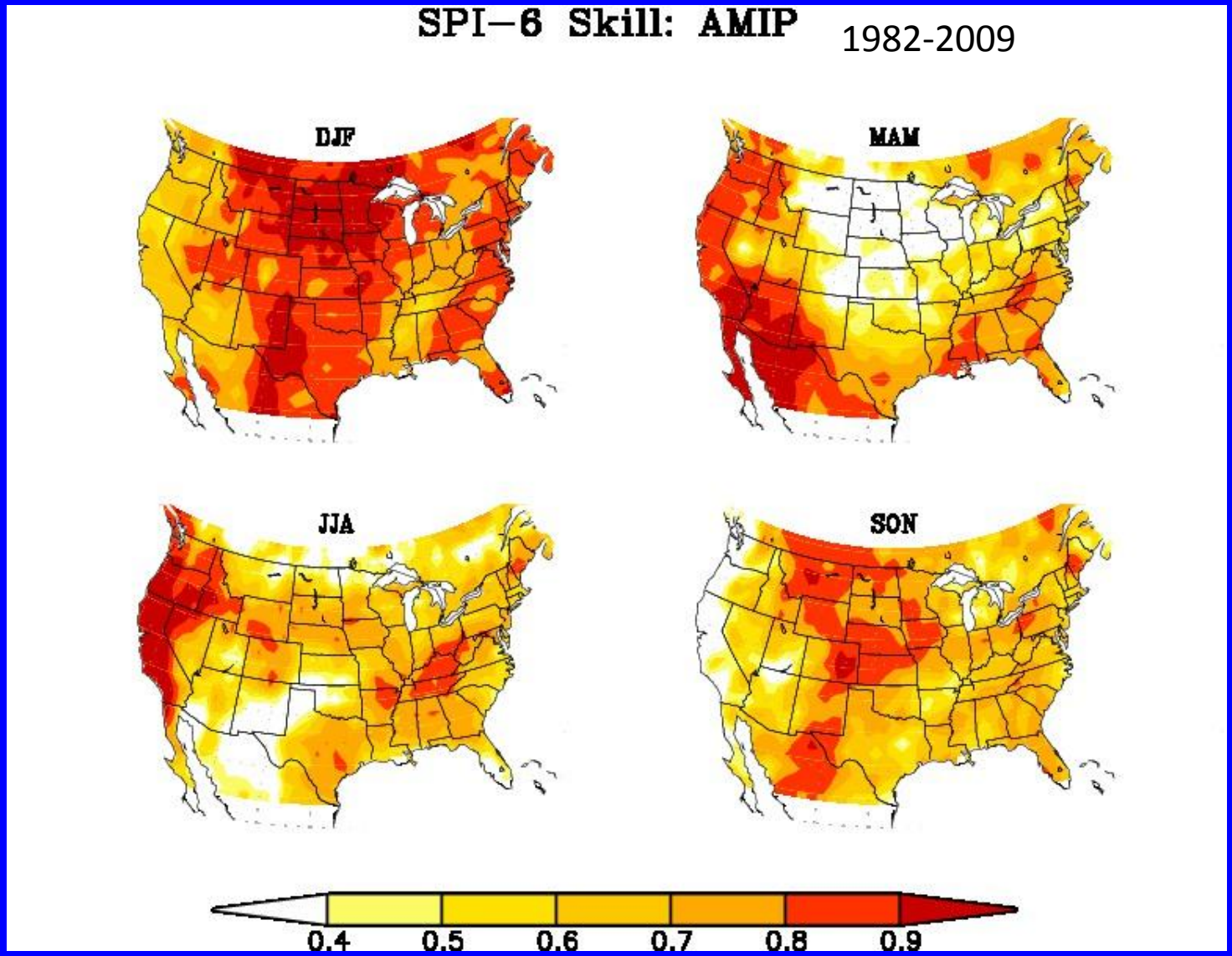


DIVISION 2
Optimal Persistence
Unconditional SPI9 Forecasts



GCM Skill SPI-6 AMIP Simulations (Correlation with Observed)

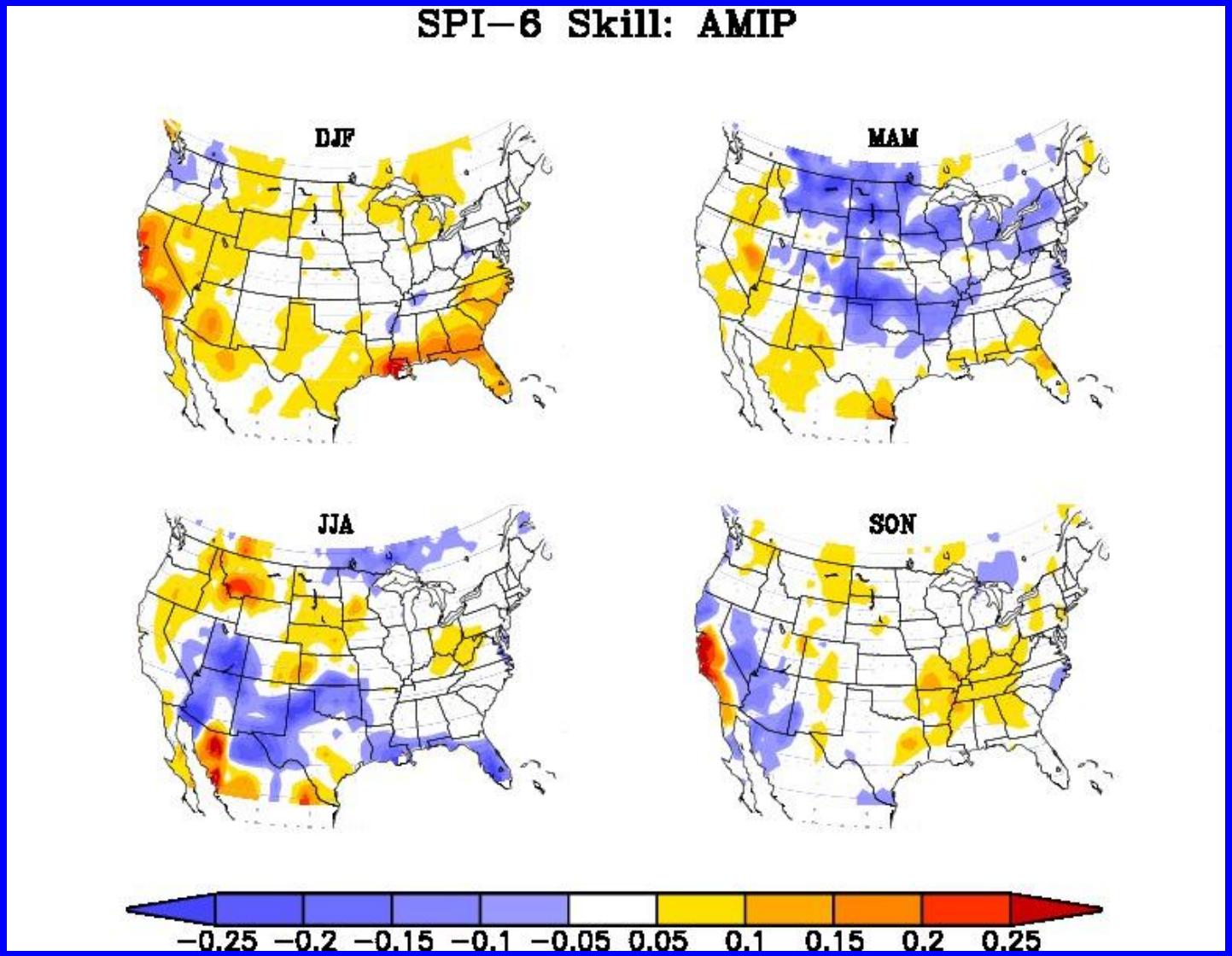
0 lead seasonal forecasts → SON (obs) + DJF (model) [CCM3.6, ECHAM4.5, ECHAM5; M=72]



Quan et al. 2011, JAMC (in review)

GCM Skill SPI-6 AMIP Simulations (Correlation - Baseline)

0 lead seasonal forecasts → Example: SON (obs) + DJF (model)



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Skill SPI-6 CFSv1 Forecasts (Correlation with Obs)

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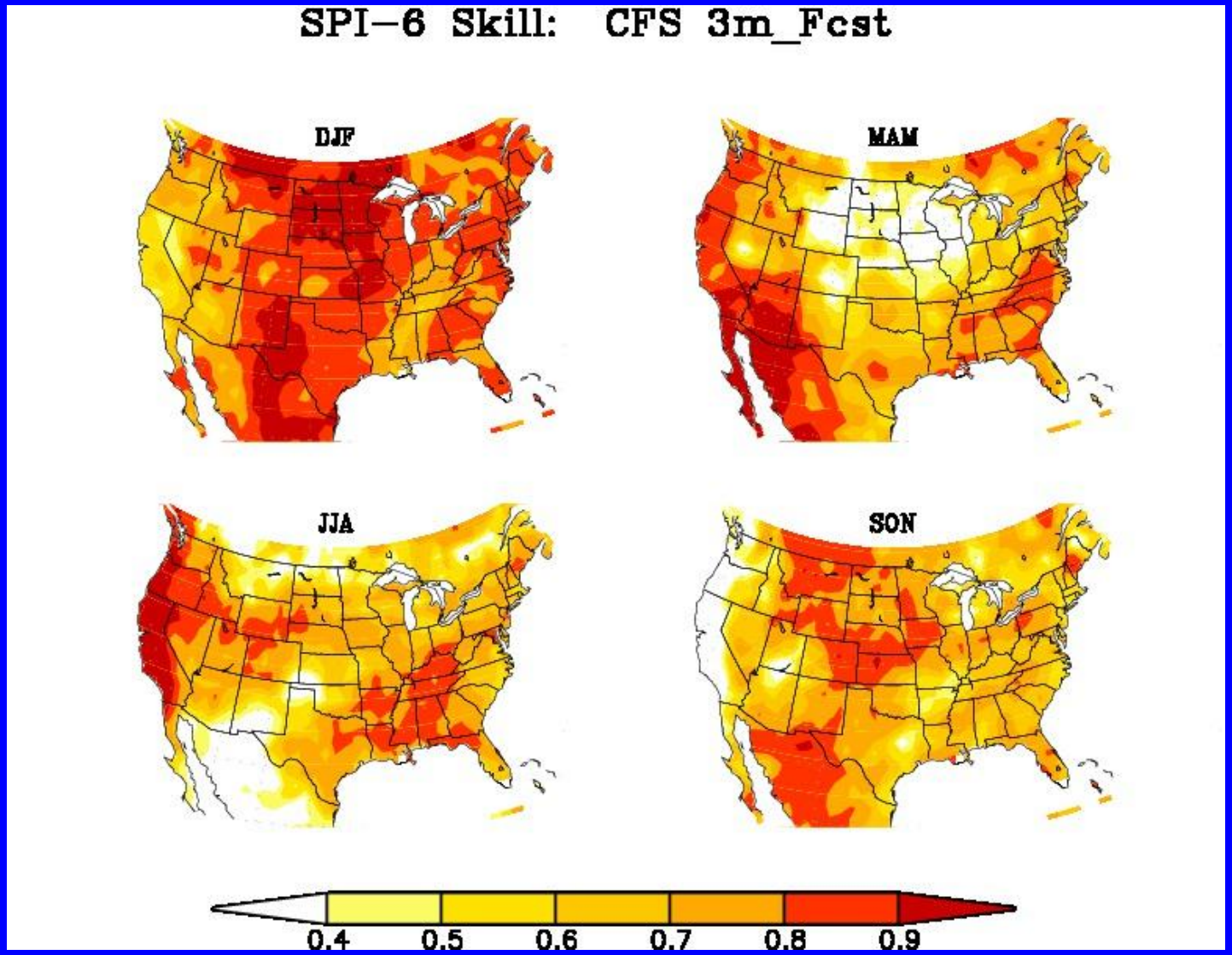

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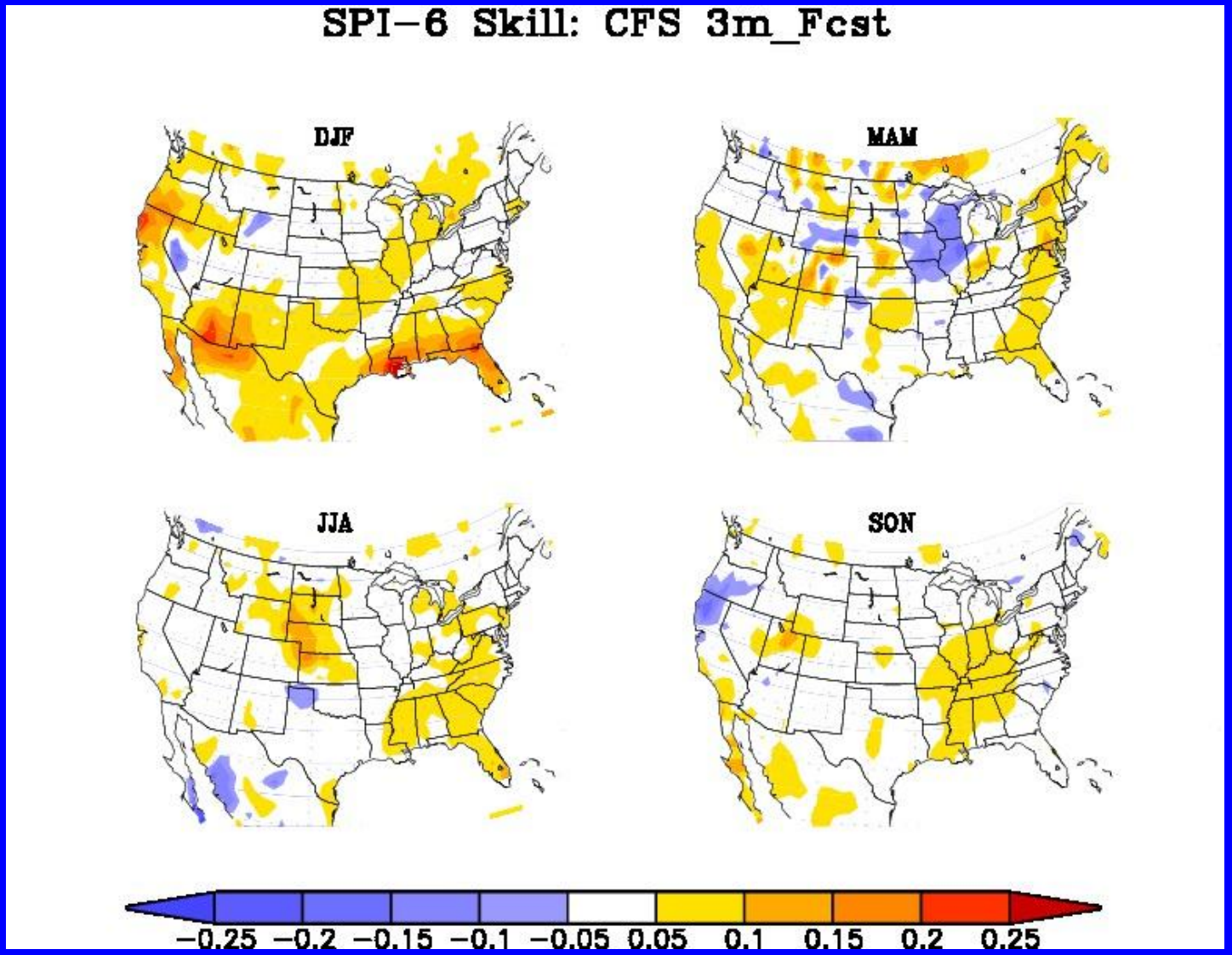

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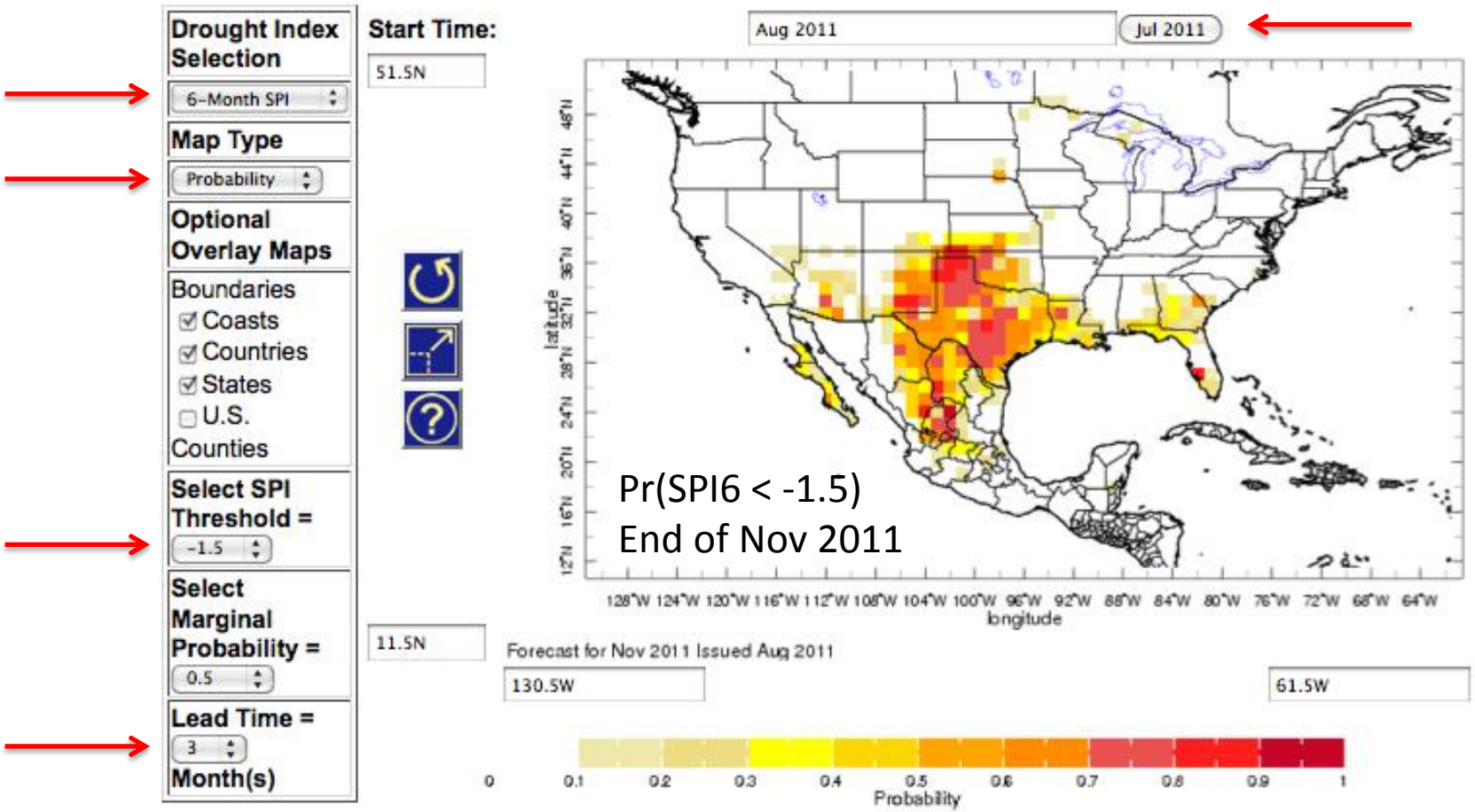
Web-Based Analysis and Prediction Tools – IRI MME Forecasts



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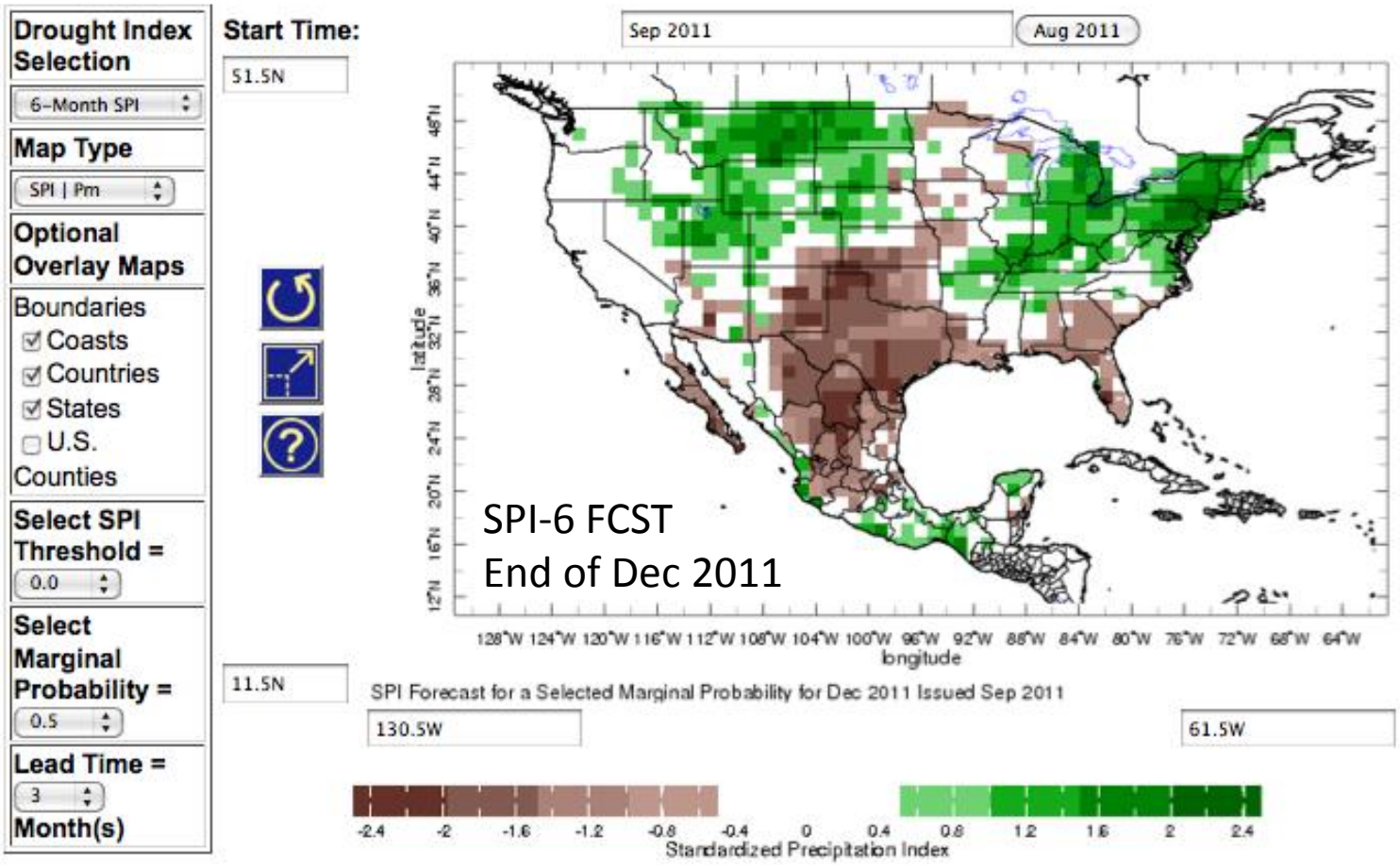

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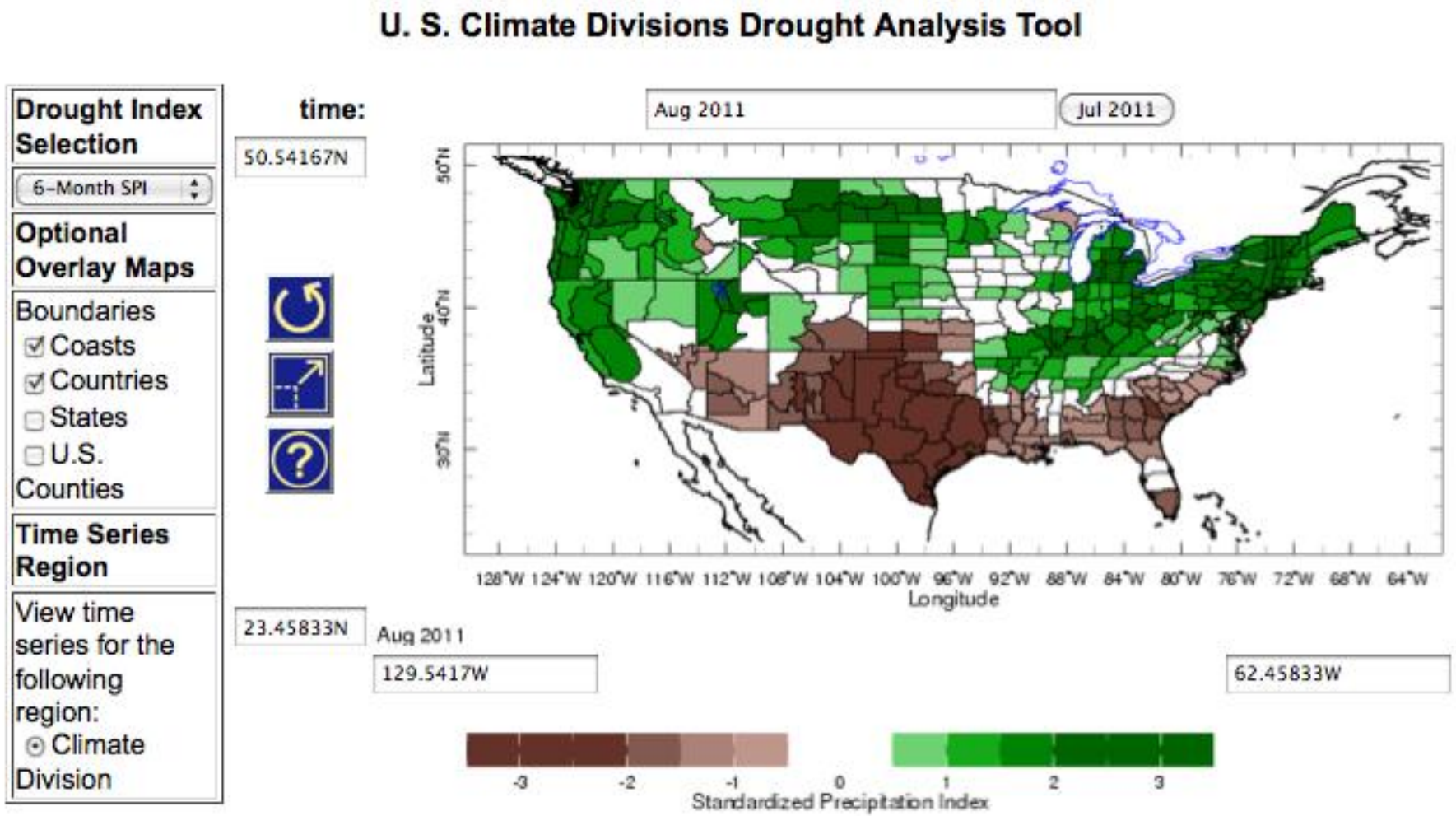
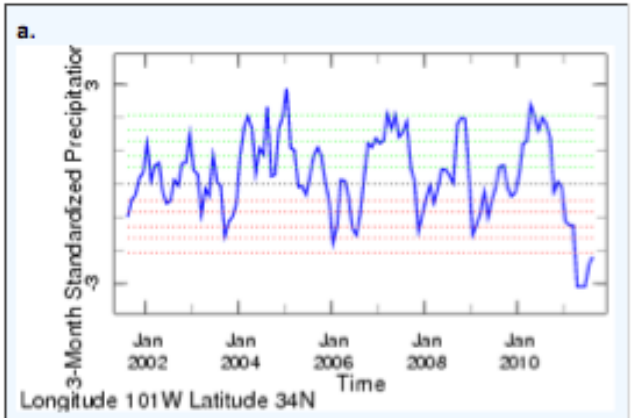
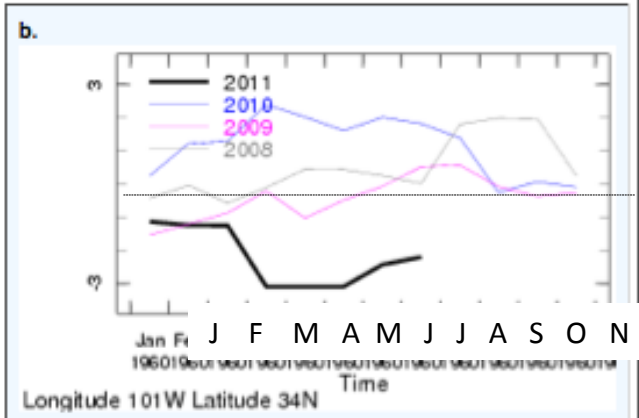


Web-Based Analysis and Prediction Tools – IRI MME Forecasts

Data for:
101W, 34N
1. x 1. deg.



Data in this graph



Description

a. Time series of Standardized Precipitation Index values for the selected region for the past 10 years.

b. Time series of Standardized Precipitation Index values for the current year [thick black line], and for the three previous years [blue: 1 calendar year ago; magenta: 2 calendar years ago; grey: 3 calendar years ago].

Red dashed lines on the plots indicate the SPI thresholds corresponding to the percentiles associated with the D0 (30%tile) to D4 (2%tile) drought intensity categories in the U. S. Drought Monitor, and green dashed lines indicate the SPI thresholds corresponding to the W0 to W4 "wetness" categories.

Data Sources

Standardized Precipitation Index

Data: The Standardized Precipitation Index series shown on this page are calculated using monthly precipitation totals at 1 deg. lat/lon resolution calculated from a dataset that combines the archived and real-time CPC U. S./Mexico daily precipitation datasets.

Data Source: U. S. Climate Prediction Center [U. S. Climate Prediction Center Daily Precipitation Analyses]

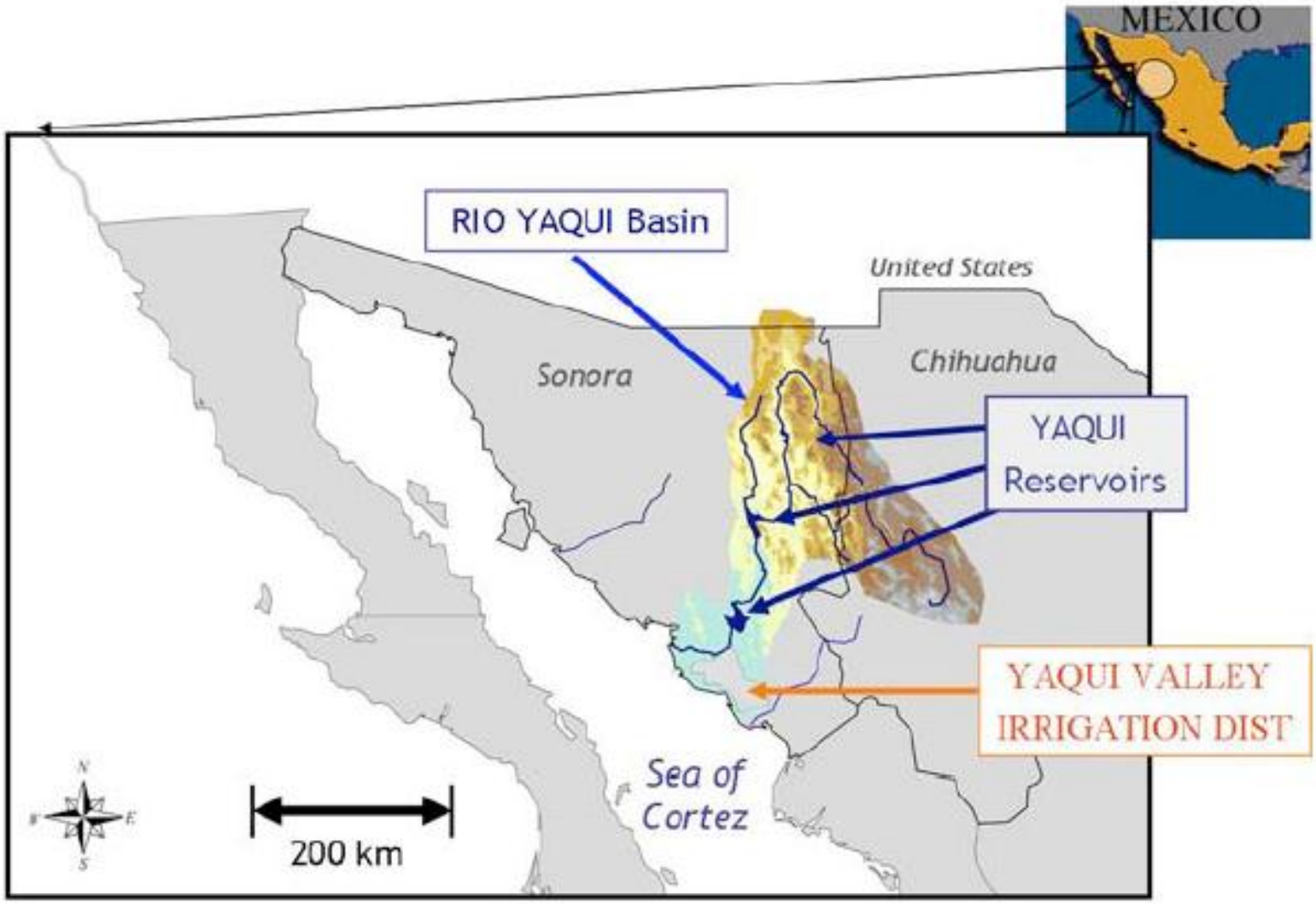
Papers:

Lyon, B., M.A. Bell, M. Tippett, M.P. Hoerling, A. Kumar, Quan, X. and H. Wang, 2011: Baseline Probabilities for the Seasonal Prediction of Meteorological Drought. *J. Appl. Meteor. Climatol.* (in revision).

Quan, X., M.P. Hoerling, B. Lyon, A. Kumar, M.A. Bell, M. Tippett, and H. Wang, 2011: Prospects for Dynamical Prediction of Meteorological Drought. *J. Appl. Meteor. Climatol.* (in review).

Bell, M.A., and B. Lyon, 2011: Web-based, Interactive Drought Analysis and Prediction Tools. *BAMS(?)* (in prep.)

The Yaqui Water System in Northwest Mexico



Graphic: L. Addams (2004)

Yaqui System: Prediction of Cumulative Inflow in Oct-Sept. from March Value

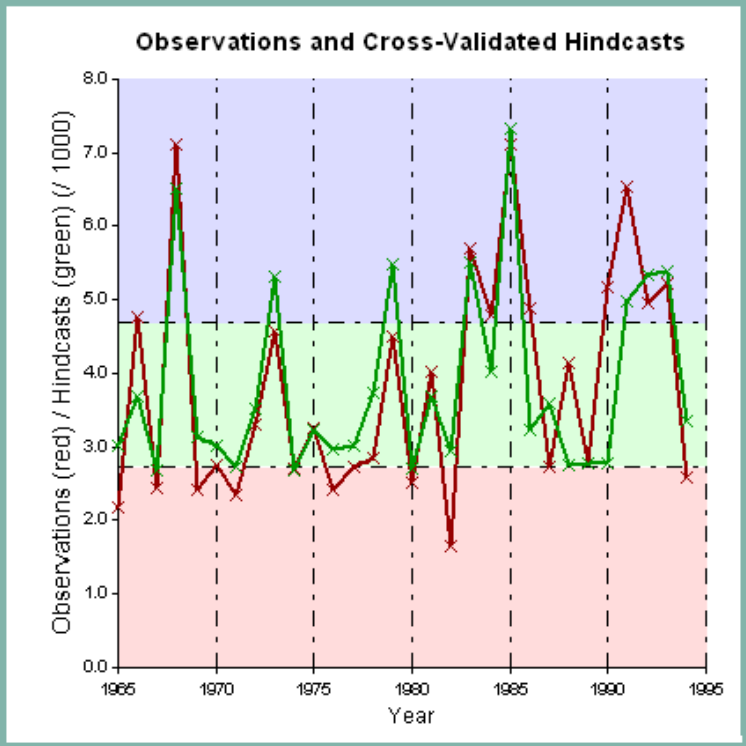
Sep_Q

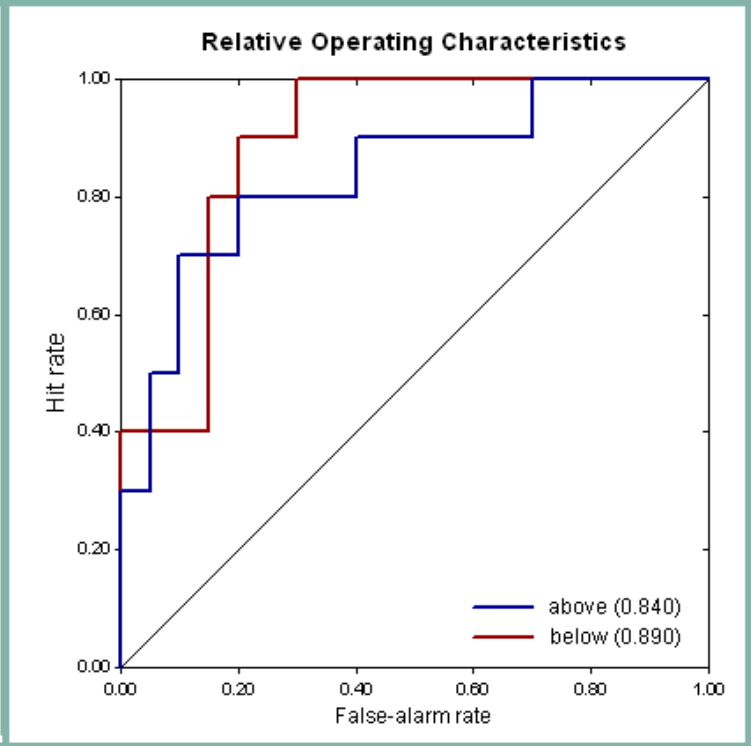
Continuous measures:

Pearson's correlation	0.8169
Spearman's correlation	0.7277
Mean squared error	754833.71
Root mean squared error	868.81
Mean absolute error	666.92
Bias	-0.21

Categorical measures:

Hit score	60.00%
Hit skill score	40.00%
LEPS score	46.67%
Gerrity score	45.00%
ROC area (below-normal)	0.8900
ROC area (above-normal)	0.8400





Data courtesy of José Louis Minjares